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KOGRUKLUK WEIR SALMON ESCAPEMENT STUDY

1989

By

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ABSTRACT

The Kogrukluk Weir project provides the most reliable chinook, sockeye, coho and chum salmon escapement data in the mid- and upper-Kuskokwim River drainage. Data has been collected since 1976. Due to abundant rain and high water, the weir was operated in 1989 from 7-14 July and 23-24 August. Historic timing data was used to estimate missing data to derive total season estimated salmon escapements of 11,940 chinook, 5,810 sockeye and 39,548 chum. Two days of coho counts in August were insufficient to provide an escapement estimate. The dominant age classes from age, length and sex (ALS) samples were ages 1.4, 1.3, 2.1, and 0.4 for chinook, sockeye, coho, and chum salmon, respectively. ALS sample sex ratios were 0.58:1 (n=217), 1.52:1 (n=68), 0.71:1 (n=29), and 0.43:1 (n=147) for chinook, sockeye, coho, and chum salmon, respectively. Length statistics are presented. During the operating period one chinook, three sockeye, and 392 chum salmon carcasses were removed from the weir.

INTRODUCTION

Description of Area

The Kogrukluk Weir project is located in the remote upper reaches of the Holitna, a major tributary to the Kuskokwim River. The Holitna River headwater is formed at the confluence of the Kogrukluk and Chukowan Rivers about one mile above the village of Kashegelok in the central Kuskokwim River drainage (Figure 1) in western Alaska.

The Kogrukluk River is formed by surface runoff from the north side of the plateau dividing the Tikchik Lakes and Nushagak River system from the Kuskokwim River system and from numerous streams which originate in the Shotgun Hills to the east. From a point about five miles from Nishlik Lake, the uppermost lake of the Tikchiks, the Kogrukluk River flows northerly for about 43 miles before it joins the Chukowan River. Shotgun Creek, a major tributary, joins the Kogrukluk about two miles upstream from the Chukowan confluence where the Holitna River begins (Figure 2).

The Kogrukluk River is characterized by swift flowing, clear water over its entire length. White spruce, birch and cottonwood forest exists along the banks in the lower fifteen miles of the stream, and frequent high runoff events in the summer erode the bank topsoil in that area and may cause considerable turbidity.

Salmon Resources

The waters of the Kuskokwim River drainage produce all five North American species of Pacific salmon (*Oncorhynchus* spp.). The species of primary commercial and subsistence importance in the region are chinook (*O. tshawytscha*), chum (*O. keta*), and coho salmon (*O. kisutch*). The traditional native subsistence fishery in the Kuskokwim area may account for as much as a third of the chum salmon harvest and half or more of the chinook salmon harvest in any year. Coho salmon have not been traditionally important in the local subsistence economy. The sport fishery in the Kuskokwim area is undeveloped, and the commercial fishery is primarily accountable for the remainder of the harvest of chinook and chum salmon. The Kuskokwim commercial coho salmon fishery is in its late development stage, and the stock has proven to be capable of sustaining substantial and economically important harvest levels since about 1978. Pink salmon (*O. gorbuscha*) are economically unimportant in the Kuskokwim area.

The Kogrukluk River is a major salmon producer in the Holitna drainage. The river is capable of significant production of chinook, chum, and coho salmon. In some years relatively large numbers of sockeye salmon (*O. nerka*) may be produced. The relative abundance of pink salmon is unknown in the Kogrukluk River, but adults are observed passing through the weir in most years.

Management Needs

The abundant quantities of economically valuable Pacific salmon which are produced in the Kuskokwim River drainage require monitoring by professional fisheries resource managers in order to optimize natural reproduction and allowable harvest. Subsistence and commercial fishermen who live along the Kuskokwim River place major cultural and economic importance upon harvests of chum and chinook salmon. The population of the Kuskokwim area is rapidly expanding. The resulting increase of pressure on the salmon resource to provide cash and subsistence food and to maintain the accustomed lifestyle of the native people is accompanied by growing interest in more efficient harvest techniques and equipment. In other fisheries, this combination has proven to be a forewarning of resource over-exploitation resulting in depletion of fish stock abundance.

Obtaining salmon escapement data from Kuskokwim River tributaries is necessary for the evaluation of the effectiveness of regulatory actions taken in the fishery. Currently there are two salmon escapement monitoring projects in the Kuskokwim drainage: the Aniak Sonar project which is designed to provide inseason chum salmon escapement data, and the Kogrukluk Weir project which provides escapement data for all indigenous salmon species except pink salmon. Additionally, a main river sonar project located on the Kuskokwim River slightly upstream of Bethel is in the late development phase and is expected to provide more comprehensive estimates of Kuskokwim drainage salmon escapements in the near future.

The Holitna River is thought to be the most important source of production of Kuskokwim chinook, chum and coho salmon. Recorded evidence of this has accumulated since 1961 (Schneiderhan 1983) when the earliest aerial survey of the Holitna River was documented. The apparent importance of the Holitna River as a salmon producer and the necessity to more closely monitor escapements of spawning salmon led to a series of attempts to establish a permanent salmon escapement monitoring project in the Holitna drainage. The Kogrukluk Weir project is the result of those attempts.

Effective harvest regulation depends on stock assessment. Test fishing near Bethel provides a good index of total returns and escapement for the drainage, but is incapable of discriminating among the stocks of salmon which spawn in various portions of the drainage. These stocks are extremely important to Kuskokwim River subsistence users, and their proper conservation is necessary for continuation as a viable, renewable resource capable of supporting new and traditional economies.

Accurate escapement data reduces the risk of adversely impacting local economies through overly conservative management practices. People in the Kuskokwim area are increasingly perceptive of the need for more and better information about upriver salmon stocks and have greater confidence in management decisions which are supported by reliable data. Annual assessment of the Kogrukluk River salmon escapements has become an important priority in the Department salmon management and research programs.

Project History

The need for accurate assessment of salmon escapements in the mid- and upper-Kuskokwim drainage stimulated the development of a salmon counting tower on the Kogrukluk River in 1971. The tower was located slightly more than a mile above the confluence of Shotgun Creek.

Inadequacies of the tower site and the absence of a more suitable nearby tower site resulted in the changeover between 1976 and 1978 from a tower counting project to a weir counting project. The weir was located downstream from the confluence of Shotgun Creek and about a mile upstream of the confluence of the Chukowan River.

From 1976 to 1978, the tower and weir were both operated to gather data for relating the results of the two projects. During that time, only the 1978 operations provided an acceptable set of data from each project.

During the early years of the project, coho salmon escapements were not monitored. Beginning in 1981 the weir was operated from June to October and coho as well as chinook, sockeye, and chum salmon data was obtained.

Objectives

The following objectives have been established for the Kogrukluk Weir project:

1. Provide daily counts of the spawning escapement of chinook, sockeye, coho, and chum salmon by sex.

2. Describe the migratory timing of chinook, sockeye, coho and chum salmon spawning escapements.

3. Describe the age, sex and size composition of the chinook, sockeye, coho and chum salmon spawning escapements.

4. Index gill net fishing intensity by comparing the frequency of gill net marked salmon at the weir with prior years.

5. Estimate carcass wash out rate and timing by species and sex.

6. Monitor variability in stream hydrologic conditions and atmospheric conditions to provide information relating to potential environmental effects on salmon production.

METHODS

Weir Construction and Maintenance

The weir consisted of black iron pipe pickets held in position by angle iron stringers, ten feet in length, which had been perforated on one side to receive about 45 pickets (3/4" black iron pipe). The stringers were overlapped and braced by "A" shaped steel pipe support pods at each ten foot juncture to span the 230 foot wide river. The triangular "A" pods were constructed of 1- 1/2" black iron pipe (schedule 80) and Kee Klamps (TM). The trap was constructed of picket pipes and stringers to dimensions of 6' x 10' x 4' deep. It had a funnel shaped entrance and was placed just upstream of an opening in the weir (Figure 3). All salmon except pink had to pass through the trap before proceeding upstream. Other details of weir construction may be found in *Ignatti Weir Construction Manual* (Baxter 1981).

Salmon Counts

Salmon were enumerated from an observation position on top of the trap. Two to four pickets were pulled out of the side of one upstream corner of the trap to allow salmon to pass. Visibility and definition were enhanced by yellow plywood flasher panels placed on the stream bottom at the exit to the trap. Twelve data categories were tallied on tally counters mounted on a pedestal near the counting position. Categories were the numbers of 1) male chinook, 2) female chinook, 3) male chum, 4) female chum, 5) male sockeye, 6) female sockeye, 7) gill net marked male chinook, 8) gill net marked female chinook, 9) gill net marked male chum, 10) gill net marked female chum, 11) gill net marked male sockeye, and 12) gill net marked female sockeye salmon. During the coho migration, the above data was maintained for the few remaining chinook, sockeye, and chum migrants; however, the primary thrust of the ensuing period was to obtain numbers of 1) male coho, 2) female coho, 3) gill net marked male coho, and 4) gill net marked female coho.

Except between 2400 and 0555 hours, the weir trap was cleared of salmon once or more an hour throughout the day and night. From 2400 to 0555 hours, the trap exit is closed; however, upstream migration of salmon during that time is usually very slow and it is unnecessary to allow passage through the weir. At 0555 hours all salmon in the trap are allowed to proceed upstream and are counted at that time. Those counts are recorded as having occurred during the six hour period 0001 - 0600 hours.

Count data was entered in a field notebook at the end of each six hour period. The following data was recorded: date, six-hour period (1,2,3 or 4), species, sex, count, and number with gill net marks. All data was recorded as specified by the project operational plan (POP, Schneiderhan 1987b).

Migration Timing Database

At the conclusion of the 1988 field season, the historic salmon count data was subjectively expanded for some years in order to produce a migration timing database with as many years represented as possible. Chinook, sockeye, coho, and chum salmon counts were examined. After the subjective expansion was performed, the migration timing database consisted of nine years of data for chinook, sockeye, and chum salmon (1976, 1978, 1979, 1981, 1982, 1984, 1985, 1986, and 1988) and eight years of data for coho salmon (1981-1988). From that data three time series models were produced which represented weir passage timing scenarios for early, normal and late migrations (Schneiderhan 1989).

Age, Length and Sex Samples

General sample size objectives were 128 samples per species for each of four time strata. This was a reduced objective from prior years which was recommended by Conrad (Alaska Department of Fish and Game, Anchorage, Personal Communication). The specific objectives for the 1989 season were defined as follows:

Pre-7 July as many as possible up to:
- 15 chinook per day
- 10 sockeye per day
- 10 chum per day

7-18 July
- 20 chinook per day
- 15 sockeye per day
- 15 chum per day

19-27 July as many as possible up to
- 15 chinook per day
- 10 sockeye per day
- 10 chum per day

28 July-9 August
- no sampling

10-24 August as many as possible up to
- 15 coho per day

25 August-9 September
- 20 coho per day

Post-9 September as many as possible up to
- 15 coho per day

Scale samples, sex and lengths were taken from salmon which were dipped from the trap while it was closed. Sampling generally took place between 0900 and 1500 hours daily. The scales were aged after the season to determine the sample age composition of each species.

Escapement sampling was performed by keeping the trap exit closed and allowing the trap to fill with salmon from downstream of the weir. When an adequate number of fish were in the trap, the entrance was also closed. Salmon were removed from the trap one at a time. Length and sex was recorded and scales collected and mounted on gummed scale cards. Mideye to fork of tail length (mm) was measured and a scale (three from chinook and coho) from the preferred area (Statewide Stock Biology Group 1984) on the left side of the fish was taken. The salmon was then carefully released on the upstream side of the weir. All salmon were dipped from each trapped sample until daily sample size goals were met or until it was impossible to meet them due to an absence of the appropriate species. All data was recorded as specified by the POP (Schneiderhan 1987b).

Salmon Carcass Counts

Salmon carcasses which washed down the river and were stopped by the weir were counted by species and sex when the weir was cleaned. During periods of moderate to heavy carcass and debris accumulation, the weir was cleaned at least once per day. At other times, one to several days may have elapsed between cleanings. Carcass data for all species was recorded in accordance with the POP (Schneiderhan 1987b).

Data Analysis

Cumulative counts to date and daily inseason estimates of total escapement were calculated daily in the Bethel Fish and Game office. The counts were entered into a Lotus 1-2-3 (TM) worksheet which calculated the two numbers. In a normal year, daily cumulative proportions by species or species and sex, mean date (Mundy 1982) of migration by species or species and sex, and mean date of carcass washout by species or species and sex were calculated in the Bethel and Anchorage offices after the season data was complete. Scale samples were pressed in acetate and analyzed by the project biologist at the end of the season. Completed OPSCAN forms containing age, sex and length data were processed through the OPSCAN reader in the Anchorage office by the project biologist at the conclusion of the field season. Custom programs and Lotus 1-2-3 macros written by Conrad (1985) were used for the initial analysis of age, sex and length data in OPSCAN output format.

Region wide standards have been set for the sample size needed to describe the age composition of a salmon population. These were applied to the time period or stratum in which the sample was collected. Sample size goals of 128 randomly selected samples in each of four time strata were chosen to estimate age composition based on a one-in-twenty chance (95% precision) of not having the true age proportion (p_i) within the interval $p_i \pm .10$ for all i ages (the accuracy of the sample). These goals would also provide a total season sample size of 512 (for a one-in-twenty chance of not having the true p_i within the interval $p_i \pm .05$ for all i ages) for potential use in allocation of escapements and catches for constructing brood year tables.

Brood year weir returns per spawner tables were updated using each year's age composition and escapement data as it became available.

Meteorologic and Hydrologic Factors

Meteorologic and hydrologic factors were measured at noon (1500 hours) each day. Maximum air temperature was measured on the max-min recording thermometer for the preceding day. Minimum air temperature was for the current day. Water temperature was measured with a pocket mercury or alcohol thermometer calibrated in either Fahrenheit or Celsius. Precipitation for the prior 24 hour period was measured using a standard precipitation gauge (10 to 1 ratio). The amount of cloud cover and wind direction and velocity was estimated by the observer.

RESULTS

Appendices A and B contain data from which tables and figures were produced for this report or analyses which may be of value to a reader but were not presented in the text. Some of the appendices are referred to briefly and some are not mentioned in the following text. The order of the appendices generally follows the order of data presentation in the text.

Salmon Counts

The weir was operated continuously from 2100 hours on 6 July to 2400 hours on 14 July and from 1900 hours on 22 August to 2400 hours on 24 August. Actual weir counts during the operational period in 1989 were 4,908 chinook, 2,597 sockeye, 1,272 coho, and 15,541 chum salmon (Table 2). The eight days of operation in July spanned the normal mean dates of weir passage for chinook, sockeye and chum salmon (10-13 July). The chinook, sockeye, and chum salmon data was augmented with estimates of daily passage for the periods 15 June to 6 July and 15 July to 22 August (Table 2). The models used in all three instances were the normal daily proportion series of historical data (Schneiderhan 1989). The two days of coho counts in August were insufficient to generate an acceptable escapement estimate. Due to the limited number of operating days, timing statistics were not calculated.

The estimated total season chinook escapement (11,940) was 119 percent of the escapement objective (10,000) for the Kogrukluk River (Table 3). The estimated sockeye escapement (5,810) was 291 percent of the objective (2,000). The estimated chum escapement (39,548) was 132 percent of the escapement objective (30,000).

Salmon Carcass Counts

A total of one chinook, three sockeye, and 392 chum salmon carcasses were counted during the operating periods. No coho carcasses were encountered during two days of operation in August (Table 4). Timing statistics of carcass accumulation on the weir were not calculated because of the brevity of the timespan of observations.

Age, Length and Sex Composition

Chinook

Age, length and sex (ALS) data was obtained from 217 live specimens. The age class composition was age 1.2 (15%), age 1.3 (25%), age 1.4 (58%), and age 1.5 (2%). The mean lengths were 570.1 mm, 705.8 mm, 864.0 mm, and 873.8 mm for ages 1.2, 1.3, 1.4, and 1.5, respectively. The female to male sex ratios were 0:1, 0.08:1, 1.21:1, and 1:1 for the respective age classes (Table 5). The sex ratio for the sample was 0.58:1 (34% female).

Sockeye

ALS data was obtained from 68 live specimens. Age classes included age 1.3 (96%), age 1.4 (1%), and age 2.3 (3%). The mean lengths were 565.6 mm, 590.0 mm, and 535.0 mm for the respective age classes. The female to male sex ratios were 1.4:1, 1:0, and 0:1, respectively (Table 6). The sex ratio for the sample was approximately 1.52:1 (56% female).

Coho

ALS data was obtained from 29 live specimens. The dominant age class was age 2.1 (97%). One specimen (3%) was age 1.1. The mean length of the dominant age class was 554.0 mm. The female to male sex ratio was 0.75:1 for the dominant age class (Table 7). The sex ratio for the sample was 0.71:1 (41% female).

Chum

ALS data was obtained from 147 live specimens. The dominant age classes were 0.3 (20%) and 0.4 (77%). Five specimens were age 0.5. The mean lengths were 568.3 mm and 595.4 mm for the respective dominant age classes. The female to male sex ratios were 0.93:1 and 0.33:1, respectively, for the dominant age classes (Table 8). The sex ratio for the sample was 0.43:1 (30% female).

Weir-based Brood Year Returns

Chinook

Spawner escapement estimates were apportioned by age class for each year (Table 9). The results were used to calculate the estimated returns above the weir per spawner above the weir (Appendix A). Estimates of catch allocated to the Kogrukluk stock were not included in the calculation of weir return per spawner. Chinook salmon weir returns per spawner were well above simple replacement levels (1.0 return per spawner) for most brood years from 1972 to 1977 (no data for 1974). The 1978 to 1983 brood year returns per spawner have ranged from 0.30 to 0.58, well below the replacement level, while 1983 returns per spawner are well over the simple replacement level at 4.58 (Figure 4).

Sockeye

Sockeye salmon spawner escapements were apportioned by age class (Table 11). Sockeye salmon weir returns per spawner were well above the replacement level in all but one brood year from 1976 to 1980. The 1981 and 1982 brood year returns were very weak. They were followed by the very strong 1983 and strong 1984 brood year returns (Figure 4).

Chum

Chum salmon spawner escapement estimates were apportioned by age class for each year (Table 11). Weir returns per spawner were well above replacement for the 1976 brood year. The 1977 to 1980 brood year returns per spawner ranged slightly above replacement (1.07 to 2.12). Very weak returns per spawner for the 1981 and 1982 brood years (0.19 and 0.30) were followed by strong returns of 1.85 and 1.43 in the 1983 and 1984 brood years, respectively (Figure 6).

Gill Net Marked Salmon

Gill net mark data similar to that presented in this report was recorded in all years of successful project operation; however, only limited attempts have been made to analyze it, and those provided inconclusive results. The relative frequency of gill net marks in 1989 appeared typical of other years. Gill net marks were relatively common on chinook and chum salmon and relatively uncommon on sockeye and coho salmon (Table 12). No attempt was made to estimate the numbers of gill net marked salmon which passed during nonoperating periods; therefore, comparisons to total weir counts or to historic data were not made.

Meteorologic and Hydrologic Factors

Meteorologic and hydrologic factors during the operating period are listed in Table 13. This type of data has been recorded each year since the project was initiated in 1976. No attempt has been made to relate meteorologic or hydrologic factors to fish production. Averages of the 1989 data are not comparable to prior years because of the short operating periods.

DISCUSSION

Management Applications

Management of the commercial salmon fisheries on the lower Kuskokwim River is more responsive to spawning ground escapement levels because of inseason projection techniques which accept cumulative escapement estimates as input. Prior to 1984, relative escapement success was not known until after aerial assessments were completed, often as late as early August. The chinook, sockeye and chum salmon commercial fisheries are usually concluded by 15 July. Using the estimates provided by daily weir data often enables fair projections of escapements beginning around 5 July. The quality of the projections improves as daily counts accumulate.

As a general rule, the most reliable early projections are obtained when the weir operation begins on or before 1 July. The preferred start up date is 25 June. That allows for documentation of earlier than anticipated migration passage. When operation is not possible until after 1 July, escapement projections using the initially available data are less reliable, because the first component of migration passage is missing from the cumulative total. After sufficient data is available, estimates can be made of the incomplete early data. The cumulative totals can then be adjusted, and more dependable inseason escapement projections can be computed.

It is important to operate the weir during the entire migrations of all species. The accuracy of the inseason projections of escapement abundance depends on the existence of a historic data base that adequately represents all of the weir passage timing scenarios that can reasonably be expected to occur.

Migration Timing Database

The migration timing data consists of daily and daily cumulative proportions of estimated weir counts of each species for all years of sufficient operational duration. This data is used to estimate portions of a current migration count which may be missed when the weir is not operating effectively. It is also the basis for inseason estimates of final total season abundance.

Currently, the migration timing database consists of usable data through 1988 (nine years for chinook, sockeye and chum and eight years for coho excluding unusable data). The essential products of the database are the migration timing models for each species. The models were applied to 1989 counts to provide the final escapement estimates reported in the results section.

Annual Escapements

Chinook

The escapement objective of 10,000 chinook was established in 1983. Based on available data at that time, it was thought to be an escapement level that could ensure continuing population levels sufficient to accomplish future escapement objectives as well as provide an adequate surplus for harvest. Chinook salmon escapement objectives were not achieved at the weir from 1983 to 1987 (Figure 5). The chinook escapement objective was narrowly exceeded in 1988 and 1989, although the species has been passively managed due to the abundance of chum salmon. Also in 1989 a fishermen's strike in late June probably resulted in an increased escapement of chinook salmon.

The improvement in chinook escapement levels in 1988 and 1989 (Figure 5) may be attributable to a significant decrease in some mortality factor as indicated by the relatively high survival rate of the 1983 brood year cohort (Appendix A.1). The 1984 and 1985 cohorts also seem to be showing early signs of relatively low mortality as indicated by strong returns of ages 1.3 and 1.2 in 1989. It appears from those indicators that Kogrukluk River returns in 1990 should be at least as strong as in 1989. Any major difference in the 1990 escapement level will be expected to be the result of differences in the prosecution of the commercial fishery.

Sockeye

Sockeye salmon have historically not been important in the Kuskokwim subsistence or commercial economies. Much larger returns in 1986 and 1987, as evidenced in the commercial catch, are thought to be a temporary anomaly. Much lower commercial harvests in 1988 and 1989 seem to support this idea.

Sockeye escapement estimates for the Kogrukluk River have exceeded the escapement objective more often and by a larger magnitude than they have fallen short (Figure 5). However, in light of the low emphasis on the species and its fluctuating status, the objective seems reasonable at this time.

Coho

Coho salmon are an economically important species in the Kuskokwim area for which there is little capability to monitor escapements at this time. If the stock were to decline, the Department would have very little ability to take corrective action without resorting to an overly conservative management regime, an option which does not optimize allocation of the resource between users and escapements.

Chum

The chum salmon escapement objective (30,000) seems reasonable. The symmetry displayed in Figure 5 demonstrates that the escapement objective is exceeded as often and by as much as it is fallen short of. The unexpectedly large chum returns in 1988 and 1989 as indicated by the large commercial harvests and good to excellent weir and Aniak River escapements (Schneiderhan 1988, 1989a) may be a sign that unknown factors are operating to create a lower pre-fishing mortality than anticipated. Improved weir returns per spawner for the 1983 and 1984 brood year cohorts (Appendix A.3) is also evidence of recent improved survival.

Gill Net Marked Salmon

The frequency of gill net marks on the various salmon species passed through the weir would appear to have potential to provide valuable information about changes in the effectiveness of the fishery when gear types or the timing or intensity of the fishery change. However, limited analyses of chinook data have been inconclusive.

CONCLUSIONS AND RECOMMENDATIONS

The spawning success of salmon stocks is more meaningfully described in terms of the female component of the escapement and of the resultant returns. When good quality sex ratio data is available for both escapements and returns, it should be used to develop brood year statistics in terms of female returns per female spawner. Female escapement objectives should also be established and used for fisheries management purposes.

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Table 1. Factor table for historical escapement estimates, Kogrukluk River, 1976-89.

	Chinook				Sockeye				Coho[a]				Chum			
Year	T[b]	Count	Prop. Missed	Est'd Total	T[b]	Count	Prop. Missed	Est'd Total	T[b]	Count	Prop. Missed	Est'd Total	T[b]	Count	Prop. Missed	Est'd Total
1976	L	5,507	0.0534	5,818	N	2,302	0.0271	2,366					N	8,046	0.0441	8,417
1977	(N)	763	0.6078	1,945	(N)	732	0.5527	1,637					(N)	7,404	0.6192	19,444
1978	N	13,132	0.0345	13,601	N	1,656	0.0255	1,699					N	47,099	0.0390	49,010
1979	N	10,125	0.1134	11,420	N	425	0.1063	476					L	3,684	0.2383	4,836
1980		676	c	6,572		403	c	3,200						5,638	c	41,777
1981	E	16,075	0.0443	16,820	E	17,702	0.0208	18,077	N	11,532	0.0004	11,537	E	56,270	0.0192	57,373
1982	E	5,325	0.5630	12,185	E	11,729	0.4706	22,156	N	35,581	0.1192	40,395	E	41,208	0.4822	79,580
1983	(N)	1,032	0.6551	2,992	(N)	375	0.6812	1,176	L	8,327	0.0218	8,513	(N)	3,248	0.6547	9,407
1984	N	4,928	0.0000	4,928	N	4,130	0.0000	4,130	E	25,304	0.0465	26,538	N	41,484	0.0000	41,484
1985	L	4,306	0.0297	4,438	L	4,344	0.0050	4,366	E	14,064	0.2406	18,520	L	15,834	0.0784	17,181
1986	L	2,968	0.3092	4,296	N	3,308	0.2084	4,179	E	14,717	0.3133	21,431	N	12,072	0.2217	15,511
1987		d		4,063		d		973e	N	19,805	0.2344	25,870		d		17,422
1988	E	7,665	0.3153	11,194	E	4,220	0.3147	6,158	N	11,722	0.0841	12,799	E	28,294	0.3244	41,881
1989	N	4,908	0.5889	11,940	N	2,597	0.5530	5,810				f	N	15,541	0.6070	39,548

a Coho migrations were not monitored prior to 1981.

b The timing model used for estimating missed counts depends on the distribution of mean date of migration from appendices C - F (E=early, N=normal, L=late). The use of parentheses () indicates assumed timing.

c From Baxter (1980); insufficient data to estimate escapements using time series techniques.

d Except for coho, escapements were estimated from a ratio of unknown 1987 escapement and known 1987 aerial assessment to known 1988 escapement and known 1988 aerial assessment. Coho escapements estimated using time series techniques.

e Aerial sockeye counts in riverine spawning habitat are subject to a wide range of error when surveys are not targeting the species.

f Heavy rain and high river levels allowed only two days of counts during the coho migration.

Table 2. Daily salmon counts by sex, Kogrukluk Weir, 1989.

Date	Chinook			Sockeye			Coho			Chum		
	Male	Female	Total [a]	Male	Female	Total [a]	Male	Female	Total [a]	Male	Female	Total [a]
15-Jun			0.0			0.0						0.2
16-Jun			0.0			0.0						0.2
17-Jun			0.0			0.0						0.8
18-Jun			0.1			0.0						0.7
19-Jun			0.6			0.0						1.3
20-Jun			0.8			0.0						5.0
21-Jun			1.8			0.2						5.4
22-Jun			4.1			0.3						13.1
23-Jun			8.6			0.7						25.9
24-Jun			14.0			2.3						25.7
25-Jun			25.6			3.3						42.5
26-Jun			28.8			3.6						71.8
27-Jun			56.5			6.4						116.7
28-Jun			78.8			9.7						203.8
29-Jun			118.5			24.9						381.7
30-Jun			121.1			35.2						529.3
01-Jul			241.3			47.9						837.9
02-Jul			284.0			81.0						1026.1
03-Jul			338.6			91.2						1263.1
04-Jul			350.7			98.7						1321.4
05-Jul			385.9			108.4						1250.9
06-Jul			424.9			171.3						1297.8
07-Jul [b]	269	164	433	30	43	73	0	0	0	707	286	993
08-Jul [b]	212	166	378	31	65	96	0	0	0	612	225	837
09-Jul [b]	219	149	368	37	114	151	0	0	0	1039	467	1506
10-Jul [b]	286	177	463	134	268	402	0	0	0	1155	571	1726
11-Jul [b]	587	300	887	213	485	698	0	0	0	1685	1126	2811
12-Jul [b]	582	350	932	142	302	444	0	0	0	1894	1187	3081
13-Jul [b]	412	221	633	189	338	527	0	0	0	1428	907	2335
14-Jul [b]	458	356	814	85	121	206	0	0	0	1408	844	2252
15-Jul			534.1			370.2						1809.0
16-Jul			550.8			323.3						1701.2
17-Jul			465.5			292.7						1511.2
18-Jul			464.6			210.1						1233.5
19-Jul			395.3			144.8						1062.4
20-Jul			296.9			144.0						936.1
21-Jul			320.0			171.7						1079.7
22-Jul			207.1			133.6						845.7
23-Jul			189.1			93.3						679.9
24-Jul			230.0			113.4						814.4
25-Jul			143.1			90.3						548.0
26-Jul			140.7			60.5						423.5
27-Jul			85.9			56.0						378.7
28-Jul			90.8			67.2						373.8
29-Jul			67.3			50.3						360.2
30-Jul			51.5			42.4						308.1
31-Jul			44.5			33.4						292.0
01-Aug			42.4			30.4						221.6
02-Aug			38.6			18.8						187.9
03-Aug			31.5			16.2						141.5
04-Aug			16.7			14.7						120.7
05-Aug			16.0			8.4						75.4
06-Aug			14.7			10.2						57.0
07-Aug			8.3			6.5						56.3
08-Aug			18.5			6.1						59.5
09-Aug			8.8			3.5						46.6
10-Aug			14.7			3.4						57.7
11-Aug			13.4			2.0						42.2
12-Aug			11.5			3.1						29.9
13-Aug			6.6			0.8						24.3
14-Aug			5.4			1.6						20.0
15-Aug			1.7			0.9						19.1
16-Aug			0.9			0.3						17.9
17-Aug			3.4			0.3						12.4
18-Aug			1.8			0.3						11.2
19-Aug			4.4			0.4						8.1
20-Aug			3.1			0.1						7.1
21-Aug			1.7			0.3						6.9
22-Aug			2.9			0.6						2.3

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Table 2. (continued) page 2 of 2

Date	Chinook Male	Chinook Female	Chinook Total[a]	Sockeye Male	Sockeye Female	Sockeye Total[a]	Coho Male	Coho Female	Coho Total[a]	Chum Male	Chum Female	Chum Total[a]
23-Aug b	0	1	1	1	0	1	353	258	611	1	0	1
24-Aug b	2	0	2	1	0	1	379	282	661	1	0	1
25-Aug												
26-Aug												
27-Aug												
28-Aug												
29-Aug												
30-Aug												
31-Aug												
01-Sep												
02-Sep												
03-Sep												
04-Sep												
05-Sep												
06-Sep												
07-Sep												
08-Sep												
09-Sep												
10-Sep												
11-Sep												
12-Sep												
13-Sep												
14-Sep												
15-Sep												
16-Sep												
17-Sep												
18-Sep												
19-Sep												
20-Sep												
21-Sep												
22-Sep												
23-Sep												
24-Sep												
25-Sep												
26-Sep												
27-Sep												
28-Sep												
29-Sep												
30-Sep												
01-Oct												
02-Oct												
03-Oct												
04-Oct												
05-Oct												
06-Oct												
Total			11940.0			5810.2						39547.5

a Counts which appear as real numbers with one decimal are estimates derived from historic data. Integers represent actual counts. Missing chinook, sockeye and chum counts were estimated from the normal migration timing model which was derived from weir data through 1988 (Schneiderhan 1988). No attempt was made to expand coho counts.

b Operating time was limited by heavy rain and high river levels.

Table 3. Historical escapement estimates and percent of objectives achieved, Kogrukluk River, 1976-89.

	Escapement Objectives			
	Chinook	Sockeye	Coho	Chum
	10,000	2,000	25,000	30,000

	Escapement Estimates				Percent of Objective			
Year	Chinook	Sockeye	Coho	Chum	Chinook	Sockeye	Coho	Chum
1976	5,818	2,366		8,417	58	118	a	28
1977	1,945	1,637		19,444	19	82	a	65
1978	13,601	1,699		49,010	136	85	a	163
1979	11,420	476		4,836	114	24	a	16
1980	6,572	3,200		41,777	66	160	a	139
1981	16,820	18,077	11,537	57,373	168	904	46	191
1982	12,185	22,156	40,395	79,580	122	1108	162	265
1983	2,992	1,176	8,513	9,407	30	59	34	31
1984	4,928	4,130	26,538	41,484	49	207	106	138
1985	4,438	4,366	18,520	17,181	44	218	74	57
1986	4,296	4,179	21,431	15,511	43	209	86	52
1987 b	4,063	973	25,870	17,422	41	49	103	58
1988	11,194	6,158	12,799	41,881	112	308	51	140
1989	11,940	5,810	c	39,548	119	291	c	132
Average					80.2	272.9	47.3	105.4

a Coho were not counted prior to 1981.

b Chinook, sockeye and chum were estimated using 1987 aerial and 1988 aerial and weir data. This should be revised as more same-year aerial and weir data becomes available.

c Heavy rain and high river levels allowed only two days of counts during the coho migration.

Table 4. Daily salmon carcass counts by sex, Kogrukluk Weir, 1989.

Date	Chinook Male	Chinook Female	Sockeye Male	Sockeye Female	Coho Male	Coho Female	Chum Male	Chum Female
15-Jun								
16-Jun								
17-Jun								
18-Jun								
19-Jun								
20-Jun								
21-Jun								
22-Jun								
23-Jun								
24-Jun								
25-Jun								
26-Jun								
27-Jun								
28-Jun								
29-Jun								
30-Jun								
01-Jul								
02-Jul								
03-Jul								
04-Jul								
05-Jul								
06-Jul								
07-Jul a	0	0	0	0	0	0	11	2
08-Jul a	0	0	0	0	0	0	25	7
09-Jul a	0	0	0	0	0	0	25	7
10-Jul a	0	0	0	0	0	0	28	10
11-Jul b								
12-Jul a	0	0	0	0	0	0	69	9
13-Jul a	0	1	0	1	0	0	91	18
14-Jul a	0	0	0	0	0	0	73	16
15-Jul								
16-Jul								
17-Jul								
18-Jul								
19-Jul								
20-Jul								
21-Jul								
22-Jul								
23-Jul								
24-Jul								
25-Jul								
26-Jul								
27-Jul								
28-Jul								
29-Jul								
30-Jul								
31-Jul								
01-Aug								
02-Aug								
03-Aug								
04-Aug								
05-Aug								
06-Aug								
07-Aug								
08-Aug								
09-Aug								
10-Aug								
11-Aug								
12-Aug								
13-Aug								
14-Aug								
15-Aug								
16-Aug								
17-Aug								
18-Aug								
19-Aug								
20-Aug								
21-Aug								
22-Aug								

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Table 4. (continued) page 2 of 2

Date	Chinook Male	Chinook Female	Sockeye Male	Sockeye Female	Coho Male	Coho Female	Chum Male	Chum Female
23-Aug a	0	0	2	0	0	0	1	0
24-Aug b								
25-Aug								
26-Aug								
27-Aug								
28-Aug								
29-Aug								
30-Aug								
31-Aug								
01-Sep								
02-Sep								
03-Sep								
04-Sep								
05-Sep								
06-Sep								
07-Sep								
08-Sep								
09-Sep								
10-Sep								
11-Sep								
12-Sep								
13-Sep								
14-Sep								
15-Sep								
16-Sep								
17-Sep								
18-Sep								
19-Sep								
20-Sep								
21-Sep								
22-Sep								
23-Sep								
24-Sep								
25-Sep								
26-Sep								
27-Sep								
28-Sep								
29-Sep								
30-Sep								
01-Oct								
02-Oct								
03-Oct								
04-Oct								
05-Oct								
06-Oct								
	0	1	2	1	0	0	323	69

a Operating time was limited by heavy rain and high river levels.

b Weir was operated but not cleaned.

Table 5. Length at age summary for chinook salmon, Kogrukluk River, 1989.

	Age Class 1.2	1.3	1.4	1.5
Females				
Mean Length	.0	798.8	886.8	917.5
Std. Error	.00	40.23	6.39	57.50
Range	0- 0	695- 880	795-1020	860- 975
Sample Size	0	4	69	2
Males				
Mean Length	570.1	698.5	836.5	830.0
Std. Error	8.36	11.19	12.59	150.00
Range	495- 780	515- 910	590-1030	680- 980
Sample Size	32	51	57	2
All Fish				
Mean Length	570.1	705.8	864.0	873.8
Std. Error	8.36	11.25	7.02	70.28
Range	495- 780	515- 910	590-1030	680- 980
Sample Size	32	55	126	4

Table 6. Length at age summary for sockeye salmon, Kogrukluk River, 1989.

	Age Class 1.3	1.4	2.3
Females			
Mean Length	549.1	590.0	535.0
Std. Error	4.91	.00	5.00
Range	500- 670	590- 590	530- 540
Sample Size	38	1	2
Males			
Mean Length	588.9	.0	.0
Std. Error	5.29	.00	.00
Range	495- 640	0- 0	0- 0
Sample Size	27	0	0
All Fish			
Mean Length	565.6	590.0	535.0
Std. Error	4.34	.00	5.00
Range	495- 670	590- 590	530- 540
Sample Size	65	1	2

Table 7. Length at age summary for coho salmon, Kogrukluk River, 1989.

	Age Class	
	1.1	2.1
Females		
Mean Length	.0	557.2
Std. Error	.00	9.39
Range	0- 0	500- 595
Sample Size	0	12
Males		
Mean Length	520.0	551.6
Std. Error	.00	6.80
Range	520- 520	500- 590
Sample Size	1	16
All Fish		
Mean Length	520.0	554.0
Std. Error	.00	5.51
Range	520- 520	500- 595
Sample Size	1	28

Table 8. Length at age summary for chum salmon, Kogrukluk River, 1989.

	Age Class		
	0.3	0.4	0.5
Females			
Mean Length	553.9	577.9	575.0
Std. Error	6.42	6.06	20.00
Range	515- 590	530- 670	555- 595
Sample Size	14	28	2
Males			
Mean Length	581.7	601.2	608.3
Std. Error	6.05	3.40	8.82
Range	530- 630	510- 680	595- 625
Sample Size	15	85	3
All Fish			
Mean Length	568.3	595.4	595.0
Std. Error	5.06	3.10	11.40
Range	515- 630	510- 680	555- 625
Sample Size	29	113	5

Table 9. Chinook salmon spawner escapements apportioned by age class and sex, Kogrukluk River, 1976-1989.

Year			Age Class 1.1	1.2	1.3	1.4	1.5	Total	Female
1976	Percent		0.3	7.2	39.5	52.7	0.3	100.0	45.1
	Number		17	419	2298	3066	17	5818	2624
1977	Percent		0.0	3.6	21.8	72.9	1.7	100.0	60.2
	Number		0	70	424	1418	33	1945	1171
1978	Percent		0.0	16.9	10.2	72.9	0.0	100.0	47.7
	Number		0	2299	1387	9915	0	13601	6488
1979	Percent		0.0	63.1	15.5	21.4	0.0	100.0	17.8
	Number		0	7206	1770	2444	0	11420	2033
1980	Percent		0.0	30.2	47.6	14.3	7.9	100.0	15.9
	Number		0	1985	3128	940	519	6572	1045
1981	Percent		0.0	6.5	33.6	58.7	1.2	100.0	47.0
	Number		0	1093	5652	9873	202	16820	7905
1982	Percent		0.3	15.1	21.2	57.8	5.6	100.0	49.2
	Number		37	1840	2583	7043	682	12185	5995
1983	Percent		0.2	20.3	23.9	51.2	4.4	100.0	28.9
	Number		6	607	715	1532	132	2992	865
1984	Percent		0.3	21.1	46.9	27.8	3.9	100.0	22.7
	Number		15	1040	2311	1370	192	4928	1119
1985	Percent		0.0	17.1	34.7	45.2	3.0	100.0	32.2
	Number		0	759	1540	2006	133	4438	1429
1986	Percent		0.1	8.7	58.3	27.1	5.7	100.0	23.0
	Number		6	373	2505	1164	247	4296	987
1987	Percent	a	0.0	25.6	24.8	48.7	0.9	100.0	3.4
	Number	b	0	1040	1008	1979	37	4063	c
1988	Percent		0.0	9.0	51.3	31.1	8.6	100.0	34.4
	Number		0	1006	5739	3482	967	11194	3848
1989	Percent	d	0.0	14.7	25.3	58.1	1.8	100.0	34.6
	Number		0	1761	3026	6933	220	11940	4127

a The age composition was calculated using 117 samples taken from the weir trap during a two day period of operation, July 15-16. Commercial catch statistics indicate a weak return of females, but it is doubtful that the actual return of Kogrukluk River female chinook salmon was as poor as is indicated here.

b Lengthy periods of high water rendered weir operation impossible during much of the chinook salmon migration. Escapement was estimated after the 1988 season using a combination of the 1988 weir count and 1987 and 1988 aerial survey counts.

c Sex composition data was unacceptable.

d Sample period 7-14 July (n = 217).

Table 10. Sockeye salmon spawner escapements apportioned by age class and sex, Kogrukluk River, 1976-1989.

Year		0.3a	1.2	0.4a	Age Class 1.3	0.5a	1.4	Other	Total	Female
1976	Percent	0.0	0.0	0.0	99.4	0.0	0.6	0.0	100.0	14.0
	Number	0	0	0	2352	0	14	0	2366	331
1977	Percent	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0	19.0
	Number	0	0	0	1637	0	0	0	1637	311
1978	Percent	0.0	2.4	0.0	90.8	0.0	6.8	0.0	100.0	57.0
	Number	0	41	0	1543	0	116	0	1699	968
1979	Percent	0.0	0.0	0.0	98.8	0.0	1.2	0.0	100.0	50.0
	Number	0	0	0	470	0	6	0	476	238
1980	Percent	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0	44.8
	Number	0	0	0	3200	0	0	0	3200	1434
1981	Percent	0.0	22.9	0.0	77.1	0.0	0.0	0.0	100.0	50.7
	Number	0	4140	0	13937	0	0	0	18077	9165
1982	Percent	0.0	0.5	0.0	87.4	0.0	11.7	0.5	100.0	37.4
	Number	0	100	0	19362	0	2594	100	22156	8284
1983	Percent	0.0	23.6	0.0	71.9	0.0	4.5	0.0	100.0	60.7
	Number	0	278	0	846	0	53	0	1176	714
1984	Percent	0.0	1.2	0.0	94.0	0.1	2.4	2.3	100.0	41.9
	Number	0	50	0	3882	4	99	95	4130	1730
1985	Percent	5.9	1.7	0.2	88.8	2.9	0.5	0.0	100.0	49.2
	Number	258	74	9	3877	127	22	0	4366	2148
1986	Percent	1.6	0.3	0.0	95.6	0.0	2.5	0.0	100.0	51.3
	Number	67	13	0	3995	0	104	0	4179	2144
1987	Percent b	2.3	0.0	0.0	97.7	0.0	0.0	0.0	100.0	60.5
	Number c	22	0	0	951	0	0	0	973	589
1988	Percent	0.0	1.8	0.0	94.8	0.0	2.1	1.2	100.0	52.7
	Number	0	113	0	5839	0	131	75	6158	3248
1989	Percent d	0.0	0.0	0.0	95.6	0.0	1.5	2.9	100.0	60.3
	Number	0	0	0	5554	0	85	171	5810	3503

a Prior to 1984, freshwater life was not carefully examined and was assumed to be two years.

b The age composition was calculated using 43 samples taken from the weir trap during four days of operation, July 15-16 and August 10-11.

c Lengthy periods of high water rendered weir operation impossible during much of the sockeye salmon migration. The data was insufficient for estimating escapements; however, 1987 aerial and 1988 aerial and 1988 weir data provided a total sockeye escapement estimate. This estimate should be changed as more data becomes available.

d Sample period 7-14 July (n = 68).

Table 11. Chum salmon spawner escapements apportioned by age class and sex, Kogrukluk River, 1976-1989.

Year			Age Class 0.2	0.3	0.4	0.5	Other	Total	Female
1976	Percent		0.5	37.0	62.5	0.0	0.0	100.0	18.5
	Number		42	3114	5261	0	0	8417	1557
1977	Percent		0.0	62.8	29.9	7.3	0.0	100.0	26.3
	Number		0	12211	5814	1419	0	19444	5114
1978	Percent		1.6	45.4	53.0	0.0	0.0	100.0	44.5
	Number		784	22251	25975	0	0	49010	21809
1979	Percent		5.7	82.5	11.8	0.0	0.0	100.0	32.0
	Number		276	3990	571	0	0	4836	1548
1980	Percent		0.0	89.2	10.8	0.0	0.0	100.0	9.6
	Number		0	37265	4512	0	0	41777	4011
1981	Percent		0.0	13.6	86.4	0.0	0.0	100.0	36.9
	Number		0	7803	49570	0	0	57373	21171
1982	Percent		0.0	70.9	28.7	0.4	0.0	100.0	43.0
	Number		0	56422	22839	318	0	79580	34219
1983	Percent		0.4	22.1	75.8	1.7	0.0	100.0	41.3
	Number		38	2079	7131	160	0	9407	3885
1984	Percent		0.0	77.7	19.5	2.8	0.0	100.0	32.6
	Number		0	32233	8089	1162	0	41484	13524
1985	Percent		0.2	30.3	69.0	0.5	0.0	100.0	45.3
	Number		34	5206	11855	86	0	17181	7783
1986	Percent		0.4	69.6	27.5	2.5	0.0	100.0	36.8
	Number		62	10796	4266	388	0	15511	5708
1987	Percent	a	0.0	22.5	69.4	8.1	0.0	100.0	45.0
	Number	b	0	3920	12091	1411	0	17422	7840
1988	Percent		0.0	69.2	28.8	1.9	0.0	100.0	35.6
	Number		0	29000	12072	809	0	41881	14905
1989	Percent	c	0.0	19.7	76.9	3.4	0.0	100.0	29.9
	Number		0	7802	30401	1345	0	39548	11837

a The age composition was calculated using 160 samples taken from the weir trap during seven days of operation, July 15-16 and August 10-14.

b Lengthy periods of high water rendered weir operation impossible for much of the chum salmon migration. The data was insufficient for estimating escapements; however, 1987 aerial, 1988 aerial, and 1988 weir data was used to estimate total escapement. New estimates should be calculated as new data becomes available.

c Sample period 7-14 July (n = 147).

Table 12. Daily counts of gill net marked salmon by sex, Kogrukluk Weir, 1989.

Date		Chinook		Sockeye		Coho		Chum	
		Male	Female	Male	Female	Male	Female	Male	Female
15-Jun									
16-Jun									
17-Jun									
18-Jun									
19-Jun									
20-Jun									
21-Jun									
22-Jun									
23-Jun									
24-Jun									
25-Jun									
26-Jun									
27-Jun									
28-Jun									
29-Jun									
30-Jun									
01-Jul									
02-Jul									
03-Jul									
04-Jul									
05-Jul									
06-Jul									
07-Jul	a	20	31	0	0	0	0	48	18
08-Jul	a	15	23	1	0	0	0	52	19
09-Jul	a	13	25	3	2	0	0	66	27
10-Jul	a	18	36	4	8	0	0	73	35
11-Jul	a	39	53	6	14	0	0	115	48
12-Jul	a	45	52	2	7	0	0	97	49
13-Jul	a	17	43	1	6	0	0	79	33
14-Jul	a	21	47	0	2	0	0	72	43
15-Jul									
16-Jul									
17-Jul									
18-Jul									
19-Jul									
20-Jul									
21-Jul									
22-Jul									
23-Jul									
24-Jul									
25-Jul									
26-Jul									
27-Jul									
28-Jul									
29-Jul									
30-Jul									
31-Jul									
01-Aug									
02-Aug									
03-Aug									
04-Aug									
05-Aug									
06-Aug									
07-Aug									
08-Aug									
09-Aug									
10-Aug									
11-Aug									
12-Aug									
13-Aug									
14-Aug									
15-Aug									
16-Aug									
17-Aug									
18-Aug									
19-Aug									
20-Aug									
21-Aug									
22-Aug									

-continued-

Table 12. (continued) page 2 of 2

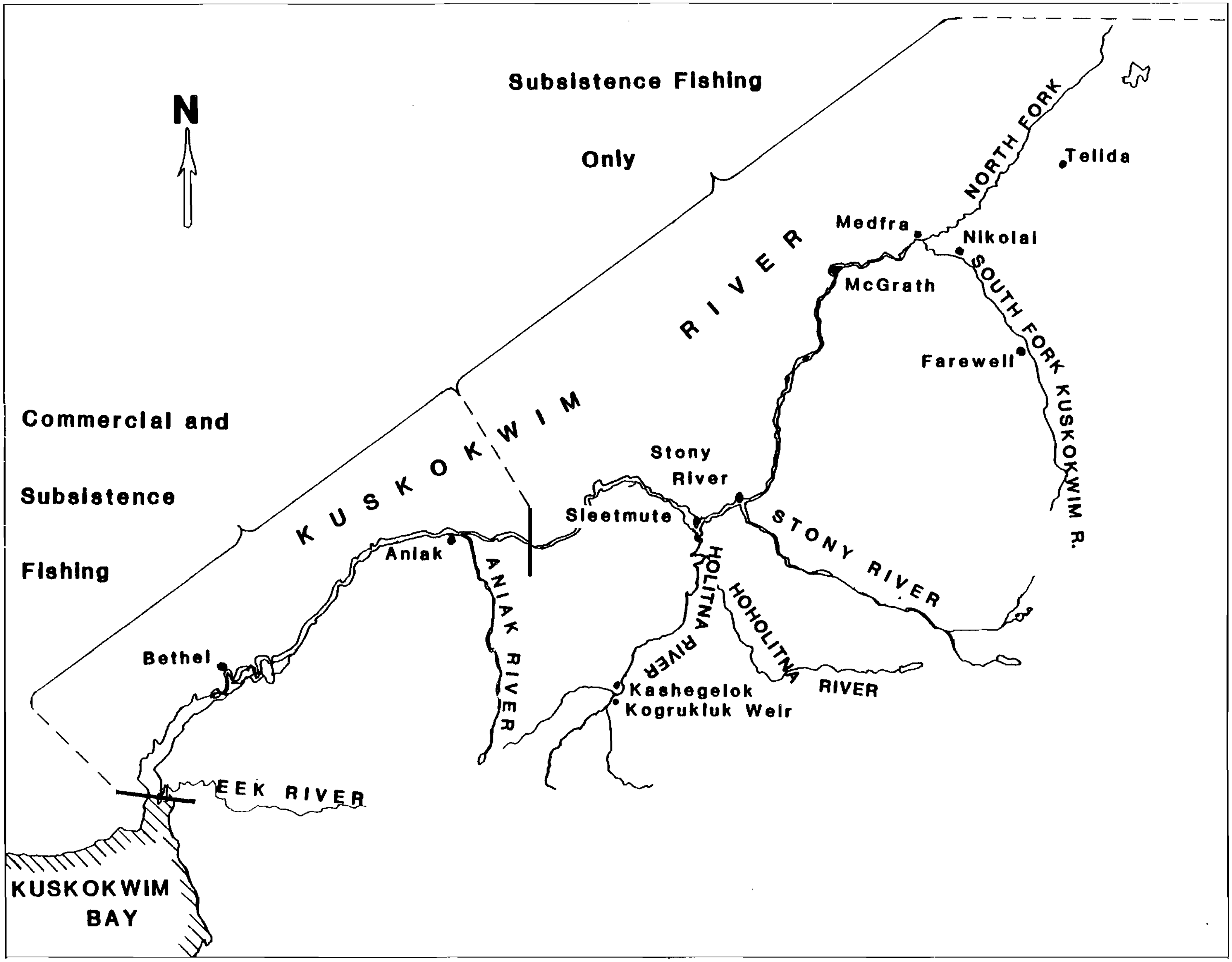
Date	Chinook Male	Chinook Female	Sockeye Male	Sockeye Female	Coho Male	Coho Female	Chum Male	Chum Female
23-Aug a	0	0	0	0	3	1	0	0
24-Aug a	0	0	0	0	6	6	0	0
25-Aug								
26-Aug								
27-Aug								
28-Aug								
29-Aug								
30-Aug								
31-Aug								
01-Sep								
02-Sep								
03-Sep								
04-Sep								
05-Sep								
06-Sep								
07-Sep								
08-Sep								
09-Sep								
10-Sep								
11-Sep								
12-Sep								
13-Sep								
14-Sep								
15-Sep								
16-Sep								
17-Sep								
18-Sep								
19-Sep								
20-Sep								
21-Sep								
22-Sep								
23-Sep								
24-Sep								
25-Sep								
26-Sep								
27-Sep								
28-Sep								
29-Sep								
30-Sep								
01-Oct								
02-Oct								
03-Oct								
04-Oct								
05-Oct								
06-Oct								
	188	310	17	39	9	7	602	272

a Operating time was limited by heavy rain and high river levels.

Table 13. Meteorologic and hydrologic factors, Kogrukluk Weir, 1989.

Date	Precipitation (mm)	Cloud Cover (%)	Wind Direction/ Vel. (mph)	Temperature (degrees F)		Water Level (mm)
				Air	Water	
26-Jun						
27-Jun						
28-Jun						
29-Jun						
30-Jun						
01-Jul	0.0	10	V<5	77	48	3080
02-Jul	0.0	10	V<5	77	50	3060
03-Jul	T	25	SE/10	72	51	3030
04-Jul	0.0	10	SE/12	75	52	2920
05-Jul	T	60	SW/10	65	50	2865
06-Jul	T	100	S/12	59	50	2845
07-Jul	3.8	90	SW/8	58	51	2835
08-Jul	0.0	100	S/5	62	52	2805
09-Jul	0.0	75	V<5	64	54	2745
10-Jul	0.0	40	S/8	66	54	2705
11-Jul	T	100	S/15	59	54	2655
12-Jul	7.8	100	S/12	63	55	2645
13-Jul	3.8	100	S<5	55	54	2645
14-Jul	19.0	100	S/10	55	54	2695
15-Jul	20.6	100	S/10	58	52	3015
16-Jul	T	75	NW/10	63	52	3265
17-Jul	0.0	50	N/10	66	54	3035
18-Jul	2.2	90	SW/15	56	52	3935
19-Jul	6.2	100	S/8	59	52	2835
20-Jul	0.0	75	S/10	63	52	2815
21-Jul	0.0	100	S/12	57	52	2785
22-Jul						
23-Jul						
24-Jul						
25-Jul						
26-Jul						
27-Jul						
28-Jul						
29-Jul						
30-Jul						
31-Jul						
01-Aug						
02-Aug						
03-Aug						
04-Aug						
05-Aug						
06-Aug						
07-Aug						
08-Aug						
09-Aug						
10-Aug						
11-Aug						
12-Aug						
13-Aug						
14-Aug						
15-Aug						
16-Aug						
17-Aug						
18-Aug						
19-Aug						
20-Aug						
21-Aug						
22-Aug						
23-Aug						
24-Aug						
25-Aug						
26-Aug						
27-Aug						
28-Aug						
29-Aug						
30-Aug						
31-Aug						

a Records for coho salmon operating period are unavailable.



Fugure 1. Kuskokwim area map.

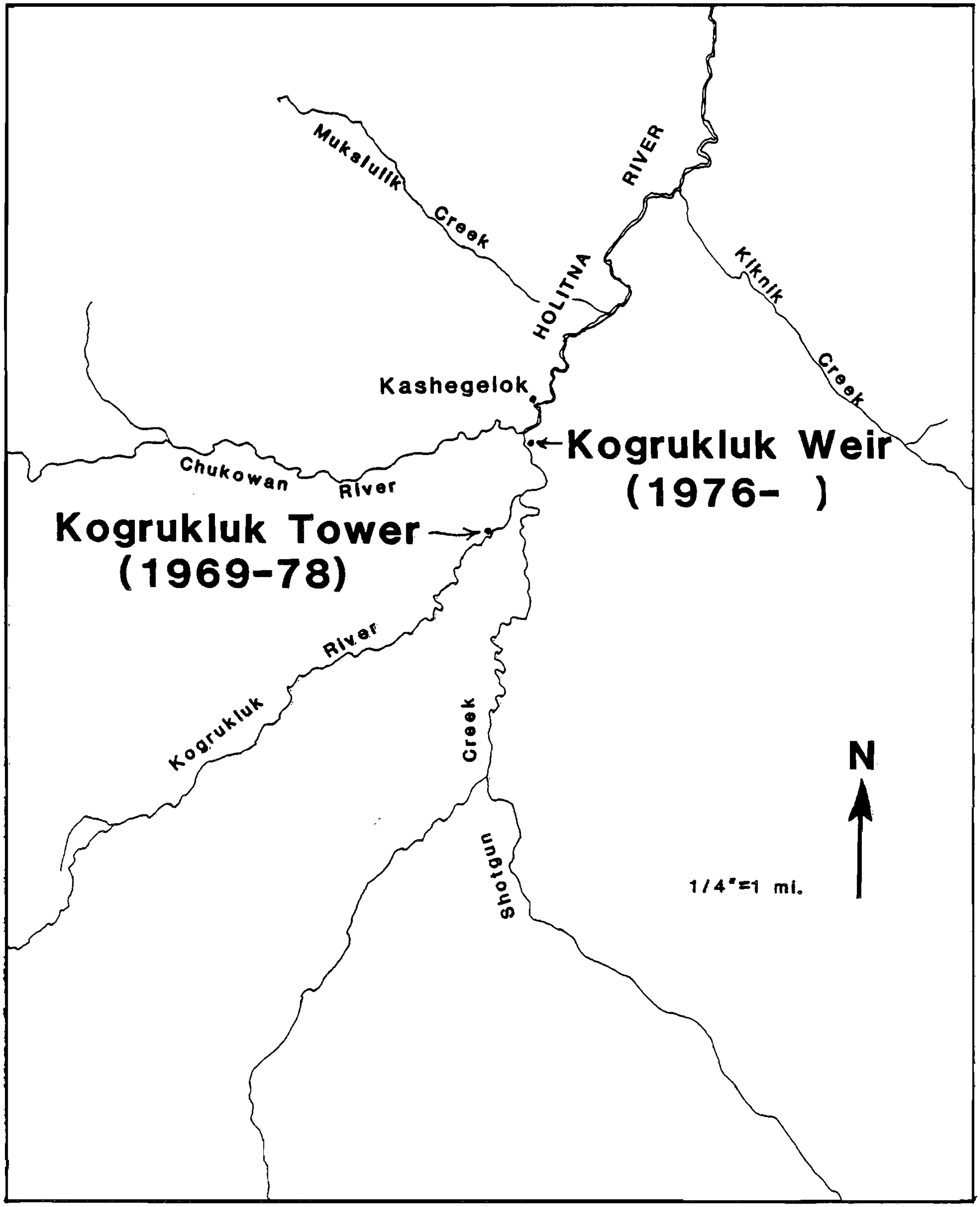


Figure 2. Upper Holitna River in the vicinity of the Kogrukluk Weir project.

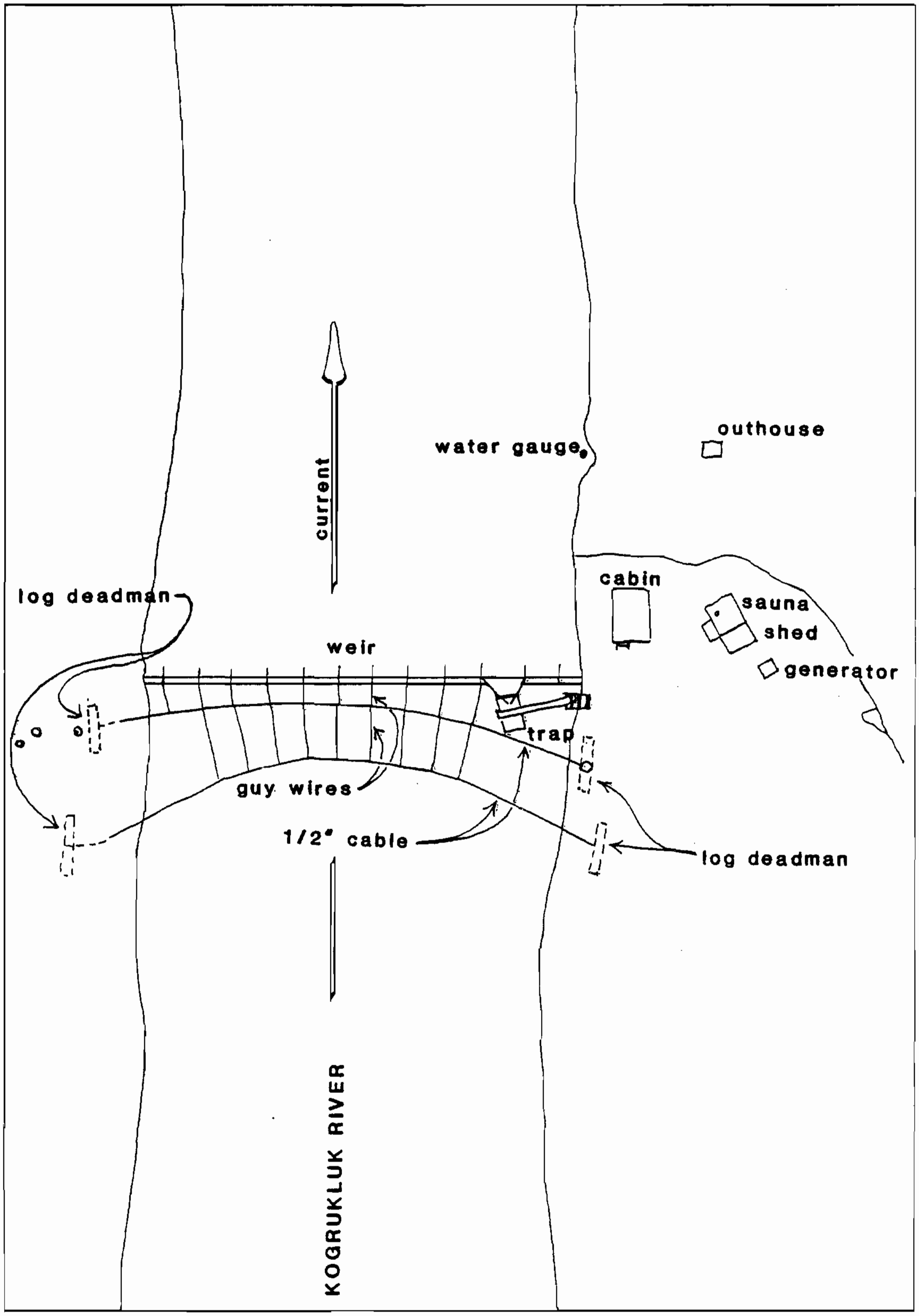


Figure 3. Kogrukluk Weir project.

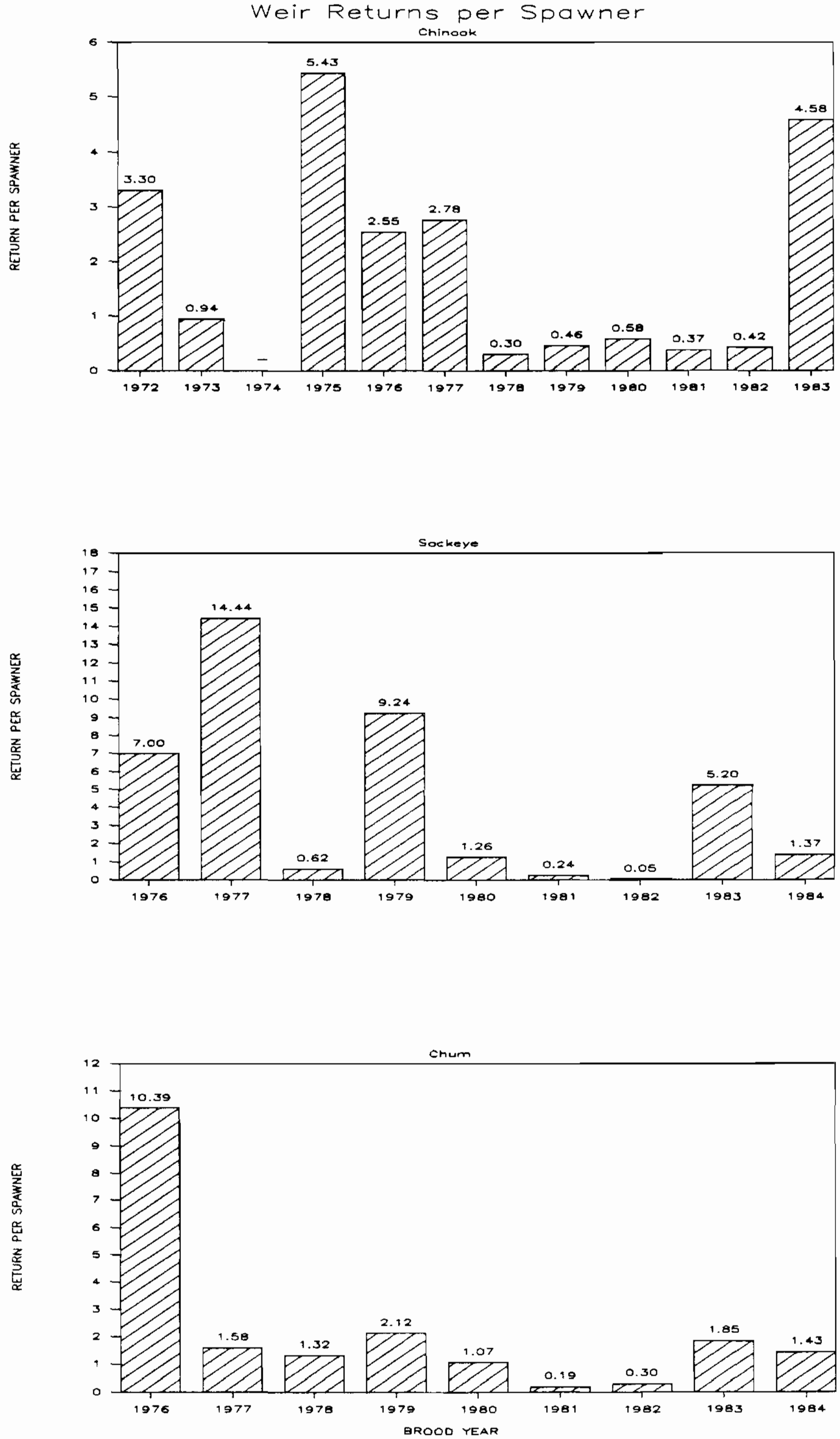


Figure 4. Estimated weir returns per spawner, Kogruk-luk River, 1972-1984.

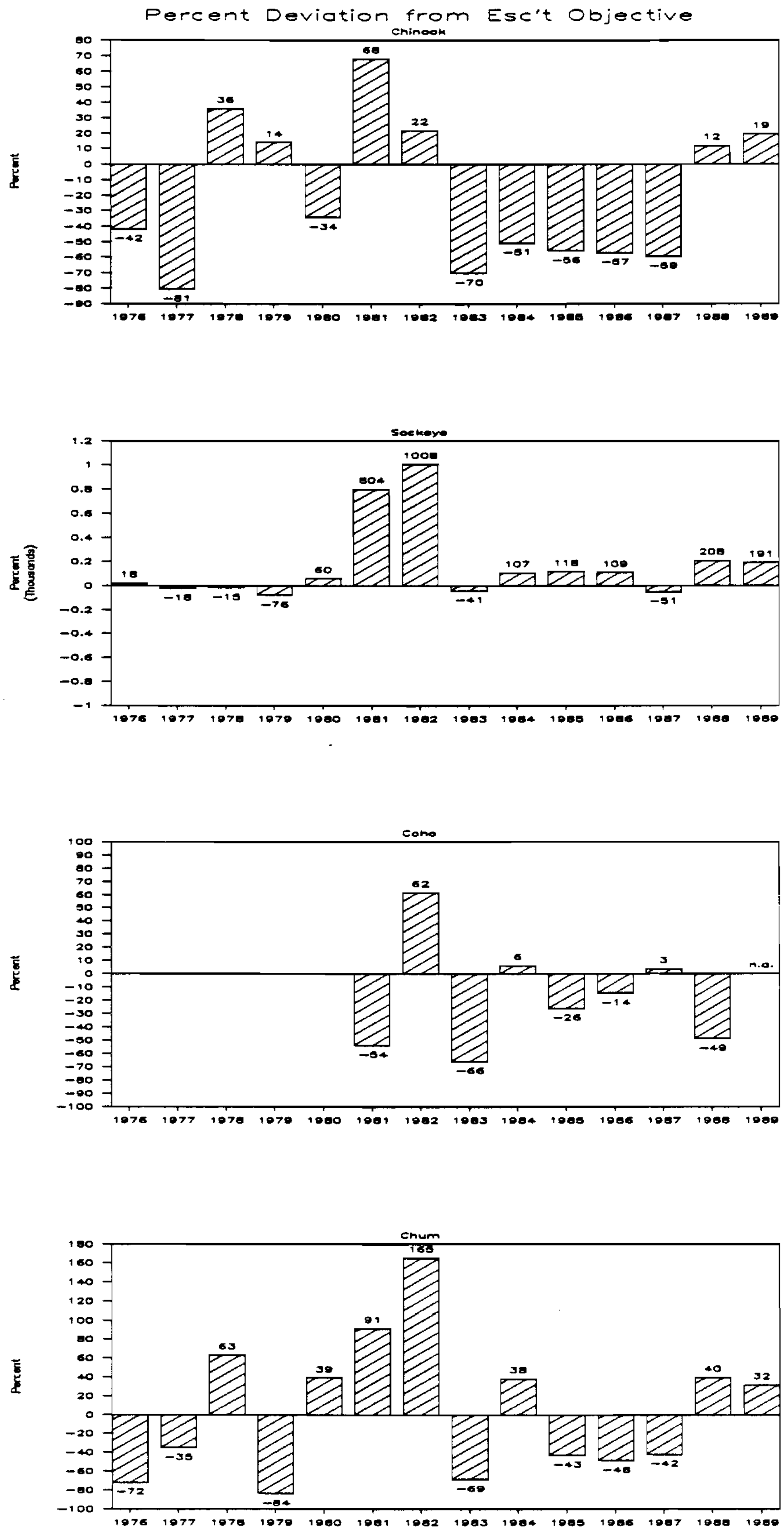


Figure 5. Percent deviation from weir escapement objectives, Kogrukluk River, 1976-1989.

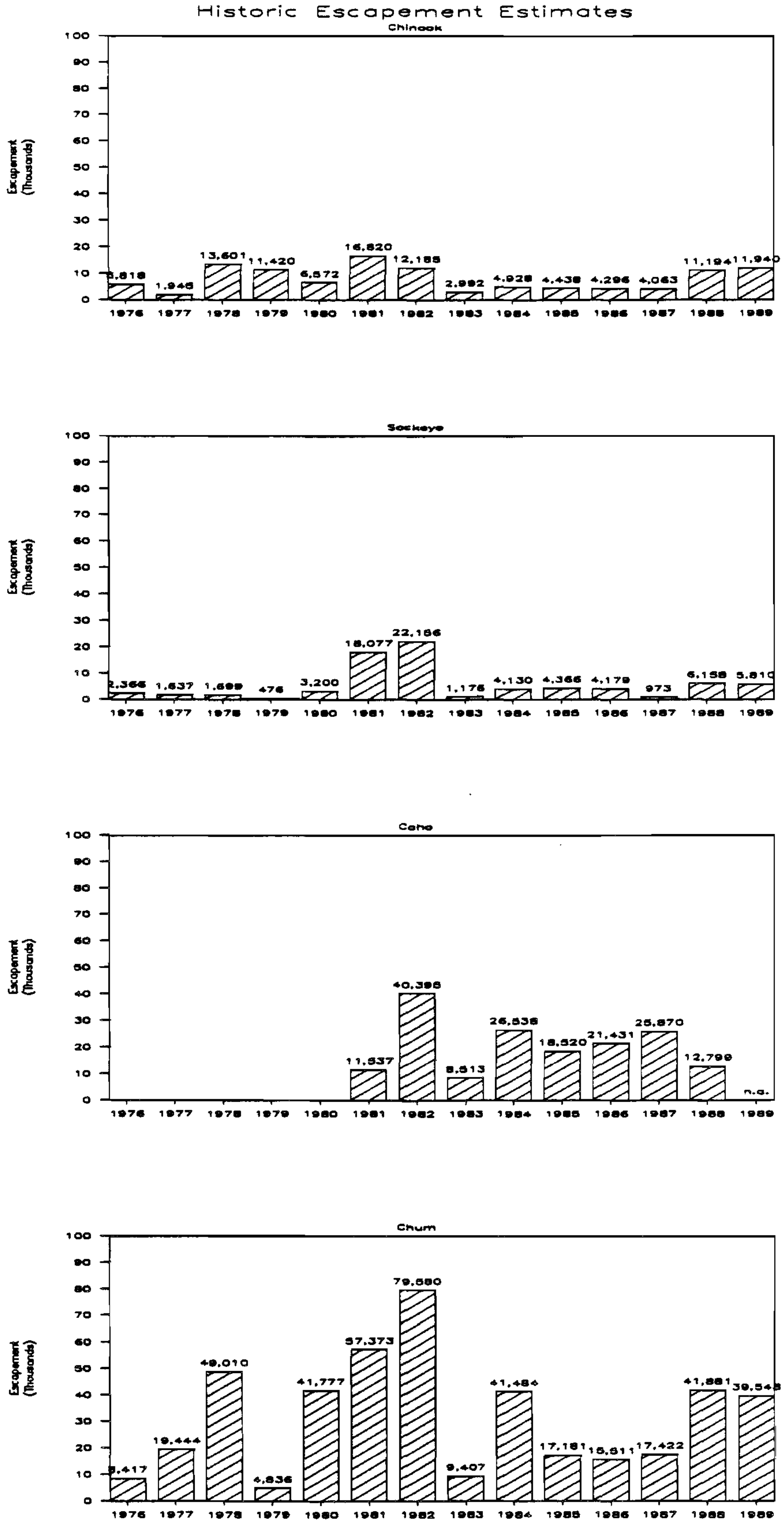


Figure 6. Estimated annual weir escapements, Kogruk-luk River, 1976-1989.

Appendix A.1. Chinook salmon brood year table, Kogrukluk River, 1969-1989.

Brood Year	Number of Spawners a	Age of Brood Year Cohort at Time of Return 1.1	1.2	1.3	1.4	1.5	Weir Returns From Each Cohort b	Weir Return Per Spawner
1969	-	c	c	c	c	17	c	
1970	3912	c	c	c	3067	33	c	
1971	-	c	c	2298	1418	0	c	
1972	3258	c	419	424	9915	0	10758	3.30
1973	4734	17	70	1387	2444	519	4437	0.94
1974	-	0	2299	1770	940	202	5211	-
1975	3844	0	7206	3128	9874	682	20890	5.43
1976	5818	0	1985	5652	7043	132	14812	2.55
1977	1945	0	1092	2583	1532	192	5399	2.78
1978	13601	0	1840	715	1370	133	4058	0.30
1979	11420	37	607	2311	2006	247	5208	0.46
1980	6572	6	1040	1540	1164	37	3787	0.58
1981	16820	15	759	2506	1978	967	6225	0.37
1982	12185	0	373	1008	3482	220	5083	0.42
1983	2992	6	1040	5739	6933	-	13718	4.58
1984	4928	0	1006	3026	-	-	-	-
1985	4438	0	1761	-	-	-	-	-
1986	4296	0	-	-	-	-	-	-
1987 d	4063	-	-	-	-	-	-	-
1988	11194	-	-	-	-	-	-	-
1989	11940	-	-	-	-	-	-	-

a Escapements prior to 1976 were estimated from tower counts. Comparability was obtained in 1977 when both tower and weir were operated successfully.

b Dominant age classes (1.2, 1.3, 1.4) are minimally used to estimate total weir return by cohort.

c Incomplete data on cohort returns.

d Weir counts in 1987 were insufficient to estimate escapements. However, 1977 aerial, 1988 aerial, and 1988 weir data was used to estimate the weir escapement.

Appendix A.2. Sockeye salmon brood year table, Kogrukluk River, 1969-1989.

Brood Year	Number of Spawners a	Age of Brood Year Cohort at Time of Return b 1.2	1.3	1.4	Weir Returns From Each Cohort c	Weir Return Per Spawner
1969	-	d	d	d	d	d
1970	-	d	d	14	d	d
1971	-	d	2352	0	d	d
1972	-	0	1637	116	1753	-
1973	-	0	1542	6	1548	-
1974	-	41	470	0	511	-
1975	-	0	3200	0	3200	-
1976	2366	0	13937	2614	16551	7.00
1977	1637	4140	19442	53	23635	14.44
1978	1699	100	845	108	1053	0.62
1979	476	278	3972	149	4399	9.24
1980	3200	50	3885	104	4039	1.26
1981	18077	332	3995	0	4327	0.24
1982	22156	80	951	131	1162	0.05
1983	1176	22	5839	256	6117	5.20
1984	4130	113	5554	-	5667	1.37
1985	4366	0	-	-	-	-
1986	4179	-	-	-	-	-
1987 e	973	-	-	-	-	-
1988	6083	-	-	-	-	-
1989	5810	-	-	-	-	-

a Tower counts of sockeye salmon prior to 1976 are unreliable indicators of escapement magnitude.

b Minor age classes are lumped with the appropriate dominant age classes for this analysis.

c Total return is estimated as the sum of the returning age classes, i.e. 1.2, 1.3, and 1.4.

d Incomplete data on cohort returns.

e Weir counts in 1987 were insufficient to estimate escapements; however, 1987 aerial, 1988 aerial, and 1988 weir data were used to estimate the escapement.

Appendix A.3. Chum salmon brood year table, Kogrukluk River, 1969-1989.

Brood Year	Number of Spawners a	Age of Brood Year Cohort at Time of Return 0.2	0.3	0.4	0.5	Weir Returns From Each Cohort b	Weir Return Per Spawner
1969	-	c	c	c	c	-	-
1970	-	c	c	c	0	-	-
1971	-	c	c	5261	1419	-	-
1972	-	c	3114	5814	0	8928	-
1973	-	42	12211	25975	0	38228	-
1974	-	0	22251	571	0	22822	-
1975	-	784	3989	4512	0	9285	-
1976	8417	276	37265	49570	318	87429	10.39
1977	19444	0	7803	22839	160	30802	1.58
1978	49010	0	56423	7130	1162	64715	1.32
1979	4836	0	2079	8089	86	10254	2.12
1980	41777	38	32233	11855	388	44514	1.07
1981	57373	0	5206	4266	1411	10883	0.19
1982	79580	34	10795	12091	809	23729	0.30
1983	9407	62	3920	12072	1345	17399	1.85
1984	41484	0	29000	30401	-	59401	1.43
1985	17181	0	7802	-	-	-	-
1986	15511	0	-	-	-	-	-
1987 d	17422	-	-	-	-	-	-
1988	41881	-	-	-	-	-	-
1989	39548	-	-	-	-	-	-

a Tower counts of chum salmon prior to 1976 are unreliable as indicators of escapement magnitude.

b Dominant age classes (0.3 and 0.4) are minimally used to estimate total weir return by cohort.

c Incomplete data on cohort returns.

d Weir counts in 1987 were insufficient to estimate escapements; however, 1987 aerial, 1988 aerial, and 1988 weir data was used to estimate the weir escapement.

Appendix B.1. Length frequencies of male chinook, Kogrukluk River, 1989.

SEX = MALES
MINIMUM LENGTH FOR THIS SEX = 495
MAXIMUM LENGTH FOR THIS SEX = 1030
MEAN LENGTH FOR THIS SEX = 727.64
HISTOGRAM CELL WIDTH SELECTED = 20
LOWER BOUND OF CELL NO. 1 = 480
TOTAL NUMBER OF CELLS = 28

CELL NO.	==LENGTH INTERVAL==	FREQUENCY....................
1	480.00 < 500.00	1 =
2	500.00 < 520.00	2 ==
3	520.00 < 540.00	4 ====
4	540.00 < 560.00	7 =======
5	560.00 < 580.00	10 ==========
6	580.00 < 600.00	12 ============
7	600.00 < 620.00	6 ======
8	620.00 < 640.00	5 =====
9	640.00 < 660.00	6 ======
10	660.00 < 680.00	7 =======
11	680.00 < 700.00	2 ==
12	700.00 < 720.00	10 ==========
13	720.00 < 740.00	8 ========
14	740.00 < 760.00	8 ========
15	760.00 < 780.00	9 =========
16	780.00 < 800.00	6 ======
17	800.00 < 820.00	13 =============
18	820.00 < 840.00	7 =======
19	840.00 < 860.00	8 ========
20	860.00 < 880.00	0
21	880.00 < 900.00	6 ======
22	900.00 < 920.00	5 =====
23	920.00 < 940.00	0
24	940.00 < 960.00	4 ====
25	960.00 < 980.00	4 ====
26	980.00 < ******	3 ===
27	****** < ******	0
28	****** < ******	2 ==

Appendix B.2. Length frequencies of female chinook, Kogrukluk River, 1989.

SEX = FEMALES
MINIMUM LENGTH FOR THIS SEX = 695
MAXIMUM LENGTH FOR THIS SEX = 1020
MEAN LENGTH FOR THIS SEX = 883.00
HISTOGRAM CELL WIDTH SELECTED = 20
LOWER BOUND OF CELL NO. 1 = 480
TOTAL NUMBER OF CELLS = 28

CELL NO.	==LENGTH INTERVAL==	FREQUENCY...............
1	480.00 < 500.00	0
2	500.00 < 520.00	0
3	520.00 < 540.00	0
4	540.00 < 560.00	0
5	560.00 < 580.00	0
6	580.00 < 600.00	0
7	600.00 < 620.00	0
8	620.00 < 640.00	0
9	640.00 < 660.00	0
10	660.00 < 680.00	0
11	680.00 < 700.00	1 =
12	700.00 < 720.00	1 =
13	720.00 < 740.00	0
14	740.00 < 760.00	0
15	760.00 < 780.00	0
16	780.00 < 800.00	2 ==
17	800.00 < 820.00	6 ======
18	820.00 < 840.00	7 =======
19	840.00 < 860.00	10 ==========
20	860.00 < 880.00	10 ==========
21	880.00 < 900.00	13 =============
22	900.00 < 920.00	10 ==========
23	920.00 < 940.00	11 ===========
24	940.00 < 960.00	5 =====
25	960.00 < 980.00	3 ===
26	980.00 < ******	5 =====
27	****** < ******	0
28	****** < ******	1 =

Appendix B.3. Length frequencies of male sockeye, Kogrukluk River, 1989.

SEX = MALES
MINIMUM LENGTH FOR THIS SEX = 495
MAXIMUM LENGTH FOR THIS SEX = 675
MEAN LENGTH FOR THIS SEX = 592.29
HISTOGRAM CELL WIDTH SELECTED = 10
LOWER BOUND OF CELL NO. 1 = 490
TOTAL NUMBER OF CELLS = 19

CELL NO.	==LENGTH INTERVAL==	FREQUENCY.............
1	490.00 < 500.00	1 =
2	500.00 < 510.00	0
3	510.00 < 520.00	0
4	520.00 < 530.00	0
5	530.00 < 540.00	0
6	540.00 < 550.00	0
7	550.00 < 560.00	0
8	560.00 < 570.00	1 =
9	570.00 < 580.00	7 =======
10	580.00 < 590.00	8 ========
11	590.00 < 600.00	5 =====
12	600.00 < 610.00	4 ====
13	610.00 < 620.00	4 ====
14	620.00 < 630.00	2 ==
15	630.00 < 640.00	1 =
16	640.00 < 650.00	1 =
17	650.00 < 660.00	0
18	660.00 < 670.00	0
19	670.00 < 680.00	1 =

Appendix B.4. Length frequencies of female sockeye, Kogrukluk River, 1989.

SEX = FEMALES
MINIMUM LENGTH FOR THIS SEX = 500
MAXIMUM LENGTH FOR THIS SEX = 670
MEAN LENGTH FOR THIS SEX = 549.64
HISTOGRAM CELL WIDTH SELECTED = 10
LOWER BOUND OF CELL NO. 1 = 490
TOTAL NUMBER OF CELLS = 19

CELL NO.	==LENGTH INTERVAL==	FREQUENCY..............
1	490.00 < 500.00	0
2	500.00 < 510.00	2 ==
3	510.00 < 520.00	3 ===
4	520.00 < 530.00	5 =====
5	530.00 < 540.00	6 ======
6	540.00 < 550.00	9 =========
7	550.00 < 560.00	11 ===========
8	560.00 < 570.00	9 =========
9	570.00 < 580.00	6 ======
10	580.00 < 590.00	2 ==
11	590.00 < 600.00	1 =
12	600.00 < 610.00	0
13	610.00 < 620.00	1 =
14	620.00 < 630.00	0
15	630.00 < 640.00	0
16	640.00 < 650.00	0
17	650.00 < 660.00	0
18	660.00 < 670.00	0
19	670.00 < 680.00	1 =

Appendix B.5. Length frequencies of male coho, Kogrukluk River, 1989.

SEX = MALES
MINIMUM LENGTH FOR THIS SEX = 460
MAXIMUM LENGTH FOR THIS SEX = 620
MEAN LENGTH FOR THIS SEX = 550.60
HISTOGRAM CELL WIDTH SELECTED = 10
LOWER BOUND OF CELL NO. 1 = 460
TOTAL NUMBER OF CELLS = 17

CELL NO.	==LENGTH INTERVAL==	FREQUENCY...........
1	460.00 < 470.00	1 =
2	470.00 < 480.00	0
3	480.00 < 490.00	0
4	490.00 < 500.00	0
5	500.00 < 510.00	1 =
6	510.00 < 520.00	1 =
7	520.00 < 530.00	2 ==
8	530.00 < 540.00	5 =====
9	540.00 < 550.00	3 ===
10	550.00 < 560.00	1 =
11	560.00 < 570.00	2 ==
12	570.00 < 580.00	1 =
13	580.00 < 590.00	5 =====
14	590.00 < 600.00	2 ==
15	600.00 < 610.00	0
16	610.00 < 620.00	0
17	620.00 < 630.00	1 =

Appendix B.6. Length frequencies of female coho, Kogrukluk River, 1989.

```
   SEX = FEMALES
   MINIMUM LENGTH FOR THIS SEX =  500
   MAXIMUM LENGTH FOR THIS SEX =  595
   MEAN LENGTH FOR THIS SEX =  555.73
   HISTOGRAM CELL WIDTH SELECTED = 10
   LOWER BOUND OF CELL NO. 1 = 460
   TOTAL NUMBER OF CELLS =  14

CELL NO.  ==LENGTH INTERVAL==  FREQUENCY............
    1       460.00 < 470.00          0
    2       470.00 < 480.00          0
    3       480.00 < 490.00          0
    4       490.00 < 500.00          0
    5       500.00 < 510.00          1 =
    6       510.00 < 520.00          1 =
    7       520.00 < 530.00          1 =
    8       530.00 < 540.00          0
    9       540.00 < 550.00          4 ====
   10       550.00 < 560.00          0
   11       560.00 < 570.00          0
   12       570.00 < 580.00          3 ===
   13       580.00 < 590.00          3 ===
   14       590.00 < 600.00          2 ==
```

Appendix B.7. Length frequencies of male chum, Kogrukluk River, 1989.

SEX = MALES
MINIMUM LENGTH FOR THIS SEX = 510
MAXIMUM LENGTH FOR THIS SEX = 680
MEAN LENGTH FOR THIS SEX = 597.95
HISTOGRAM CELL WIDTH SELECTED = 10
LOWER BOUND OF CELL NO. 1 = 510
TOTAL NUMBER OF CELLS = 18

CELL NO.	==LENGTH INTERVAL==	FREQUENCY	....
1	510.00 < 520.00	2	==
2	520.00 < 530.00	0	
3	530.00 < 540.00	2	==
4	540.00 < 550.00	1	=
5	550.00 < 560.00	2	==
6	560.00 < 570.00	9	=========
7	570.00 < 580.00	12	============
8	580.00 < 590.00	11	===========
9	590.00 < 600.00	12	============
10	600.00 < 610.00	14	==============
11	610.00 < 620.00	21	=====================
12	620.00 < 630.00	12	============
13	630.00 < 640.00	5	=====
14	640.00 < 650.00	3	===
15	650.00 < 660.00	1	=
16	660.00 < 670.00	3	===
17	670.00 < 680.00	1	=
18	680.00 < 690.00	1	=

Appendix B.8. Length frequencies of female chum, Kogrukluk River, 1989.

```
   SEX = FEMALES
   MINIMUM LENGTH FOR THIS SEX =  515
   MAXIMUM LENGTH FOR THIS SEX =  670
   MEAN LENGTH FOR THIS SEX =  570.10
   HISTOGRAM CELL WIDTH SELECTED = 10
   LOWER BOUND OF CELL NO. 1 = 510
   TOTAL NUMBER OF CELLS =  17

CELL NO.  ==LENGTH INTERVAL==  FREQUENCY...............
    1        510.00 < 520.00         1 =
    2        520.00 < 530.00         1 =
    3        530.00 < 540.00         5 =====
    4        540.00 < 550.00         3 ===
    5        550.00 < 560.00         7 =======
    6        560.00 < 570.00         7 =======
    7        570.00 < 580.00         6 ======
    8        580.00 < 590.00         6 ======
    9        590.00 < 600.00         4 ====
   10        600.00 < 610.00         1 =
   11        610.00 < 620.00         5 =====
   12        620.00 < 630.00         0
   13        630.00 < 640.00         1 =
   14        640.00 < 650.00         0
   15        650.00 < 660.00         0
   16        660.00 < 670.00         0
   17        670.00 < 680.00         1 =
```